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Policy Perspectives to Appropriate Air Quality Management Strategy Options in Nigeria

Chinwe A. Onwudiegwu*; Ibikunle O. Ogundari, Olawale O. Adejuwon and Joshua B. Akarakiri

African Institute for Science Policy and Innovation. Obafemi Awolowo University, Ile-Ife, Nigeria
*Corresponding author's email address: chinweaonwudiegwu@gmail.com

Abstract

In recognition of the far-reaching nature of the effects and damages which different forms of pollution pose to the Country's citizenry, the Nigerian government has formulated various environmental policies to safeguard the Nigerian environment. Nigeria's increasing population, expanding industrial activities, rising fuel demands and global green policies development has necessitated the need to strengthen and/or develop, where applicable, policy measures to cater for ambient air quality standards for the protection of the air environment. This study therefore aimed to examine the technological policy perspectives in air quality management policy in the Nigeria by providing appropriate air quality management and strategy options in Nigeria. The study developed a process-based conceptual framework to help policy makers develop requisite policy options involving Goal setting, Baseline air quality assessment, Air quality monitoring (Monitoring, Emission inventories, Atmospheric dispersion modeling) Intervention strategies and implementation of intervention strategies. The study concludes that a comprehensive air quality control policy/act that focuses on multiple pollutants and emission sources at both the zonal and national levels is recommended to mitigate air pollution issues in Nigeria.

Keywords: Air pollution; Air quality, Environmental protection

1.0. Introduction

After the Rio Earth Summit convened in 1992, it was realized that sustainable development and good environmental management are two sides of the same coin (Sinha, 2015). That is, sustainable development depends on good environmental management just as good environmental management depends on sustainable development. Unless environmental considerations are incorporated into developmental planning, implementation and evaluation, the future of the World's species that constitute the bio-diversity and natural balance of the planet, cannot be assured (Sinha, 2015).

Air quality is a cause for concern in Nigeria, particularly in cities as air pollutants including particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), and ozone (O_3) are uncontrollably and unabatedly being released into the atmosphere daily in quantities that have remained unknown. Ambient air pollution emanates from three major sources namely, energy generation, industry, and transportation; all of which increase with population and economic growth (Ezeh *et al.*, 2012). With increasing urban populations, Nigeria is faced with a severe situation of energy consumption, electricity generation and vehicle population leading to increase in multiple pollutant emissions. This situation in Nigeria, given the lack of effective urban planning, has caused severe degradation in air quality. Heavy dependence on oil-dominated transportation in key urban centres such as Lagos, more than any other single human activity, has been revealed to be the major contributor to severe air pollution in Nigeria (Onwudiegwu, 2014).

In recognition of the far-reaching nature of the effects and damages different forms of pollution pose to the country's citizenry, the Nigerian government enacted various environmental policies to safeguard the Nigerian environment (Offiong, 2011). Since the Constitution of the Federal Republic of Nigeria (1999) provides for a three-tiered governmental structure that consists of the Federal Government (FG), the State Governments (SGs), and the Local Governments (LGs), the framework for the management of the environment was integrated into these three levels. However, a review of the various environmental laws and policies in existence in Nigeria show that all aspects of pollution of the environment with the exception of the air environment have been addressed by these policies (Offiong, 2011).

Nigeria's increasing population, expanding industrial activities, rising fuel demands and global green policies development have necessitated the need to strengthen and/or develop, where applicable, policy measures to cater for ambient air quality standards for the protection of the air environment. Such standards are usually geared towards the reduction of atmospheric levels of carbon dioxide and other greenhouse gases, fine particles, oxides of nitrogen and sulphur as well as other toxic air pollutants. To enforce regulatory compliance to improvements of urban air quality requires the recognition of a need for legislated air quality standards, the political will to formulate it, supported by scientific research/studies and establishment of monitoring systems. Such systems are generally nonexistent in Nigeria. The aim of this study therefore is to examine the technological policy perspectives in air quality management policy in the Nigeria by providing appropriate air quality management and strategy options in Nigeria.

2.0. Literature Review
2.1. Air Pollution

Air is said to be polluted when the natural quality has been altered to the extent that the atmosphere's carrying capacity to maintain steady state concentration of chemical and biological constituents has been over-stretched by source strengths (Obioh et al., 1993). Different sources emit specific pollutants into the atmosphere at rates related to process chemistry and source emissions. Increasing source emissions increase the atmospheric concentration of the pollutants, biogenic transfers as well as impacts to human health and environmental resources. The effect of air pollution depends on the nature, concentration and chemistry of the air pollutants.

2.2. What causes air pollution?

The major air pollution problem in the developed and industrialized countries had typically been high levels of smoke and SO_2 arising from the combustion of fossil fuels that contain Sulphur. However, the major threat to air pollution is now posed by traffic emissions (Ezeh, 2014). Petrol and diesel driven motor vehicles emit a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NOx), volatile organic compounds (VOCs) and particulates matter (PM), which have an increasing impact on urban air quality. In addition, photochemical reactions resulting from the action of sunlight on nitrogen dioxide (NO_2) and VOCs from vehicles leads to the formation of O_3, a secondary long-range pollutant, which impacts in rural areas often far from the original emission site. Acid rain is another long-range pollutant influenced by vehicular NOx emissions. In all situations, industrial and domestic pollutant sources impact on air quality trends over time and vehicular traffic pollution problems have been reported to be worsening world-wide (Eldred & Nakai, 2012).

2.3. Present and future challenges of air pollution occurrence in Nigeria

Over the past five decades, Nigeria has experienced dramatic economic growth in terms of industrialization. This however has impacted negatively on the Country's environment. An inventory of air pollutants in Nigeria revealed that the industrial sector (led by cement production) is the highest anthropogenic source of PM emissions (Obioh *et al.*, 1993; Obioh 1995; Obioh & Adegbulugbe 1996; Obioh *et al.,* 2004). Many more studies have been undertaken to understand and assess the impacts of emissions from this sector on ambient air quality, occupational exposure and public health (Oluwole *et al*., 1988; Adejumo *et al*., 1994; Asubiojo *et al*., 1994; Ogunsola *et al.,* 1995; Oluwole *et al*., 1995 and Ikamaise *et al*., 2001; Oluyemi & Asubiojo, 2001 & Ezeh *et al.*, 2012). The sources of ambient PM were quantified for marine, traffic, regional sulphate and industrial sources from these studies with the relative proportions of the contributions of these sources being soil (35-54%), marine (26-34%), automobile exhaust (0.3-3.5%), refuse incineration (2-3%) and regional sulphate (2-12%). Oluwole *et al.* (1988) revealed that high deposition rates of PM and elemental constituents are indicative of the rates at which pollutants are transferred to soils, water resources and vegetation.

Energy consumption, especially fossil fuel consumption, is the main source of anthropogenic air pollution emissions in Nigerian cities such as Lagos. In terms of development and industrial infrastructure in the Country, Lagos accounts for 68% of industries, 38% of energy consumption and 50% of vehicular population (Oketola and Osibanjo, 2009b). As a mega city in one of the most underdeveloped continents of the world, Lagos has myriads of environmental challenges (Ezeh et al 2012). Some border on its limited land mass and high population, the fact that it is highly unplanned, lacking in industrial hygiene practices and effective enforcement of urban planning management and environmental laws (Onwudiegwu, 2014). There are many other urban areas in the country with rapid urban growth rates, which differ widely in industrial and other urban infrastructure growth rates from what obtains in Lagos. However, they follow the same growth and pollution trend in proportions related to the source strength of the pollution (Onwudiegwu, 2014).

The Niger Delta region of Nigeria is an urban area in the country that provides the basis for the need for urgent and critical air pollution management policies in the county. This is because there is daily, alarming, continuous and unquantified release of air polluting culprits into the atmosphere as a result of gas flaring in that region. The urban air quality of Nigeria no doubt has been polluted with high concentrations of sulfur and nitrogen oxides, ozone, volatile organic compounds, persistent organic pollutants, heavy metals, particulate matter, including black carbon, and ammonia for many years mainly due to its coal-dominated energy structure. With rapid urbanization and development of transport infrastructure, vehicular exhaust pollution has also aggravated the menace of air pollution in Nigeria. As the economy of the country continues to grow, Nigeria will continue to face more severe situations of energy consumption, electricity generation and increase in the usage and population of vehicles, leading to increase in multiple pollutant emissions. Controlling air pollution especially fine particles that deplete the ozone layer, as well as lowering carbon emissions from fossil fuel consumption is a big challenge for the country.

2.4. Environmental laws and policy in Nigeria

Environment legislation in Nigeria was viewed broadly under two time-related categories by Offiong (2011). This study reported that the first set of laws (between 1930s and 1990s) were enacted as a result of the fact that the Nigerian government recognized the damaging effects of floods, droughts, forest fires, technological accidents such as oil spills, industrial chemical effluents, dumping of toxic wastes and contamination of rivers, lakes, soil, air and other forms of pollutions of the environment. The second group of laws consists of particular legislation, consequent guidelines, standards and regulations introduced with the creation of the Federal Environmental Agency by Decree No. 58 of 1988.

The Federal Environmental Protection Agency (FEPA) was charged with the overall responsibility of protecting and developing the Nigerian environment. FEPA Decree 58 of 1988 authorizes this agency among other things to establish and prescribe national guidelines, criteria and standards for water quality, air quality and atmospheric protection, noise levels, gaseous emissions and effluent limits; to monitor and control hazardous substance, supervise and enforce compliance. This Decree also gave the agency broad enforcement powers, even without warrants, to gain entry, inspect, seize and arrest with stiff penalties of a fine or jail term on whosoever obstructs the enforcement in the discharge of their duties or makes false declarations of compliances.

The Federal government through Decree 86 of 1992 promulgated another law on Environmental Impact Assessment (EIA) which was aimed at protecting the Nigerian environment. This decree made it compulsory for any project that may have adverse effects on the environment to carry out an environmental impact assessment before execution. It sought to assess the likely or potential environmental impacts of proposed activities, including their direct or indirect cumulative, short-term and long-term effects on the environment (Obioh, *et al,* 2013).

In addition, the EIA Decree had the responsibility of identifying the measures available to mitigate adverse environmental impacts of proposed activities and assessment of the identified measures. The execution of this decree was meant to be supervised by the Federal Environmental Protection Agency and by the State environmental protection Agency of each Nigerian state. Other laws include the Nigerian government promulgated Harmful Wastes Decree which was meant to provide the legal framework for the effective control of the disposal of toxic hazardous waste into any environment within the confines of Nigeria. NESREA was established by the Federal Government in line with section 20 of the 1999 Constitution of the Federal Republic of Nigeria, as a parastatal of the Federal Ministry of Environment. By the NESREA establishment Act 2007, the Federal Environmental Protection Agency Act Cap F 10 LFN 2004 has been repealed. The bill for an act establishing NESREA was passed on 31st July 2007 and was signed by the president of the nation Umaru Musa Yar'adua.

3.0. Theoretical Framework for Policy Formulation

The theoretical framework describes the policy formulation process. It involves the following steps:

a. **Problem identification:** before a policy can be created, a problem must be identified and   brought to the attention of the relevant authorities and the attention of the government.

b. **Strategy for solving the problem:** at this stage, approaches for solving the identified problem are looked at and discussed.

c. **Legislation support needed:** the national assembly, the executive, and the judiciary are involved at this stage of policy formulation. Different proposals are looked at until a tangible outcome is reached and a bill is passed to the National Assembly. The process continues with adoption and national Assembly passes legislation,

d. **Implementing Institutions:** at this stage, adopted policies are put into effect as implementation or carrying out of policy is most often accomplished by institutions other than those that formulated and adopted it. A statute usually provides just a broad outline of a policy however; relevant institutions and authority are responsible for the details of such a statute. For example, although the National Assembly may mandate improved air quality standards, but the Federal Environmental Protection Agency

(FEPA) or NESREA would provide the details on those standards and the procedures for measuring compliance through regulations.

e. **Evaluation:** policies may be evaluated according to a number of standards. They may be informally evaluated according to uncritical analysis, such as anecdotes and stories. Policies may also be substantively evaluated through careful, honest feedback from those affected by the policies. More formal research can provide empirical evidence regarding the effectiveness of policies. Finally, scientific research provides both comparative and statistical evaluations of whether policies produce clear causal results.

4.0. Air Quality Management Intervention and Strategy Options

Air pollution mitigation policies are expected to be appropriate and adequate in order to effectively meet national objectives of protecting the air environment. In the face of increasing air pollution challenges in the country as a result of increasing population growth, industrial activities, and the increased attention on global green policies development, it is imperative for Nigeria to strengthen national formulation and implementation of air pollution policies and fortify National Ambient Air Quality Standards (NAAQS) to halt the problems associated with air pollution. The air pollution laws would provide means for the control and abatement of air pollution and also seek to combat air quality deterioration by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to air pollution. NAAQS are levels of air quality necessary with an adequate margin of safety, to protect public health, vegetation and property (Gupta, 1999).

The practice that obtains in most countries is that National Ambient Air Quality Standards (NAAQS) prescribe specific standards for industrial, residential, rural and other sensitive areas. Industry-specific emission standards have been developed for iron and steel plants, cement plants, fertilizer plants, oil refineries and the aluminum industry in India (Divan and Rosencranz 2001). The ambient quality standards prescribed in India are similar to those prevailing in many developing and developed countries. For instance, China did not only establish different levels of ambient standards, applicable in different areas but also took the lead in establishing separate standards for the smaller particles (less than 10 μm in diameter) that are considered more harmful to human health (Siddiqi & Chong-Xian, 1984).

Similarly, in the United States of America, the EPA developed the basic structure for the Clean Air Act in 1970 and made major revisions in 1977 and 1990 to improve its effectiveness and to target newly recognized air pollution problems such as acid rain and damage to the stratospheric ozone layer. To protect public health and welfare nationwide, the Clean Air Act required EPA to establish national ambient air quality standards for certain common and widespread pollutants based on the latest science. Further to this, EPA set air quality standards for six common "criteria pollutants": particulate matter (also known as particle pollution), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. The Clean Air Act also required individual States to adopt enforceable plans to achieve and maintain air quality which meet the air quality standards set by EPA. In the subsection below, a conceptual framework for the establishment of NAAQS and an air quality policy (AQA) in Nigeria is discussed in response to the need to tackle and reduce air pollution to its barest minimum in Nigeria.

5.0. Conceptual framework

The conceptual frame work describes the process for the development and implementation of NAAQS to ensure clean air quality in Nigeria. It is a dynamic process which involves the following steps:

A. **Goal setting:** This provides the basis for the formulation of the NAAQS to be developed by FEPA/NESREA in consultation with a technical committee and stakeholders. The goals for the NAAQS would be consistent with the applicable NESREA legislation which would be reflected in the vision and mission statements. How these goals are to be achieved should be addressed through objectives and target

B. Baseline air quality assessment: a baseline air quality assessment would be undertaken by NESREA zonal offices in each of the six geopolitical zones of Nigeria to assess and evaluate the current air quality status. The baseline air quality assessment would involve an assessment of available air quality data, air pollution sources, and area data. It may include:

    i.   Area description and boundary definition
    ii.   Description of the meteorology and climate
    iii.   Population statistics
    iv.   Evaluation of air quality information based on available data
    v.   Sources and emissions
    vi.   Pollutants of concern
    vii.   Priority air quality issues
    viii.   Evaluation of current management and tools
    ix.   Consideration air quality impacts of future developments
    x.   Prioritizing areas for intervention air quality monitoring

C. Air quality monitoring: This would involve the following steps to be carried out by the NESREA zonal offices in each of the six geopolitical zones of Nigeria.
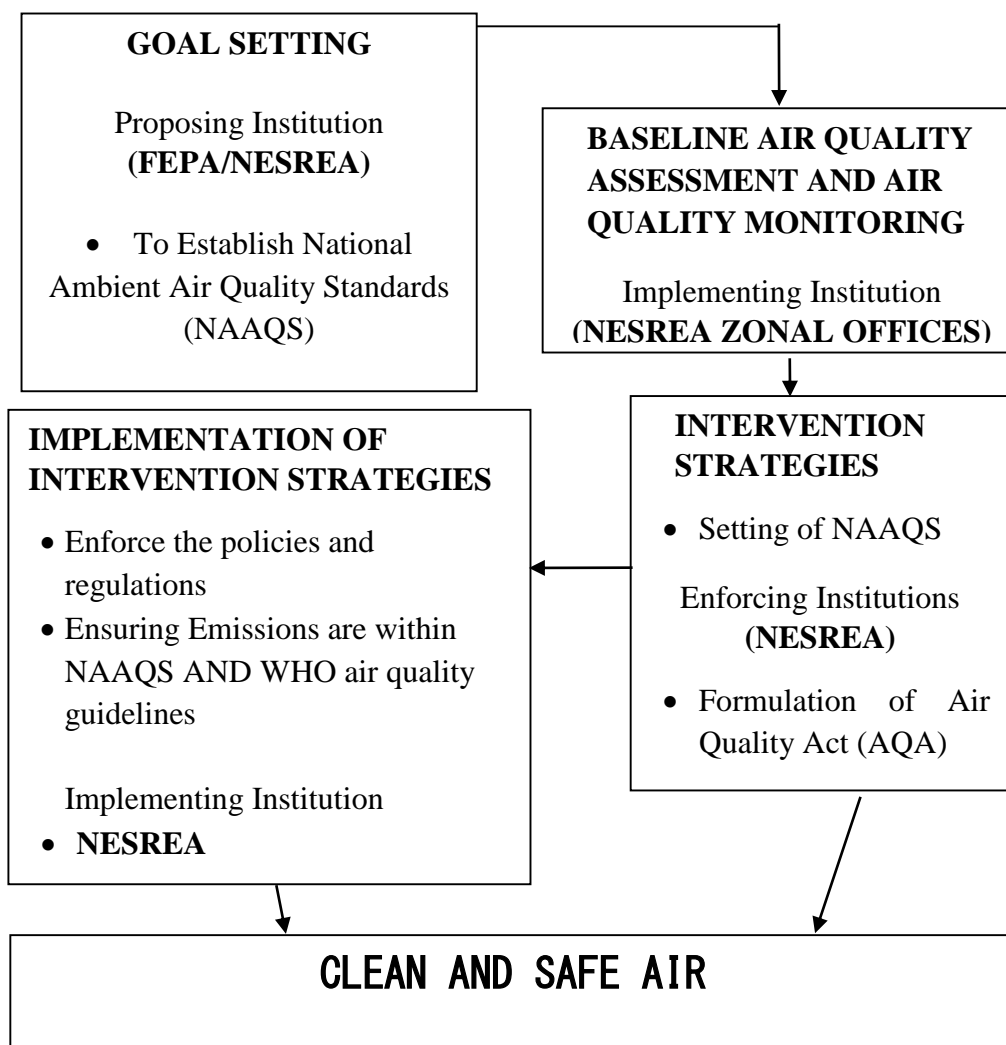
    a. **Monitoring:** involves the collection of data to provide necessary information to enable informed decisions on improving air quality. The level of sophistication of the monitoring system will depend on the results of the baseline assessment. While a sophisticated continuous monitoring network may be required for poor air quality areas, the use of passive samplers may suffice for potentially poor and acceptable air quality areas.

    b. **Emission inventories:** this is a list of all sources of pollution within the area with details of their location and volume of pollutants emitted.

    c. **Atmospheric dispersion modeling:** air quality modeling which combines knowledge of pollutant sources with meteorological data to estimate concentrations at receptor points would also be done. Models allow for the assessment of exposure and risk, impact areas and forecasting. The information obtained can then be applied to manage and improve air quality through developing the best actions needed.

D. Intervention strategies: The air quality monitoring results would be used to give direction to the development of intervention strategies. These may include strategies to reduce air emissions and air pollution impacts such as the establishment of NAAQS by NESREA, enactment of the AQA by the National Assembly, establishment of machinery for capacity building, awareness campaigns or even further research. In addition to that, sanctions, penalties for defaulters would be determined at this stage by the FEPA, NESREA, and stakeholders. The objective is to identify the most cost-effective measures and actions to reduce air pollution impact by controlling the sources.

E. Implementation of intervention strategies: This ensures that the interventions identified in Step 4 are implemented. The objective is to:

    a. Implement the control strategies, including financing the control measures and setting a time frame,
    b. Identifying how to implement intervention strategies/ action plans,
    c. Enforcing the policies and regulations needed to implement the strategies,
    d. Charging defaulters to court and where need be, prosecuting them.

The agencies that would implement the control strategies are NESREA, the Ministry of Transport, Manufacturers Association of Nigeria and the Federal High courts which would prosecute any defaulters.

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│         GOAL SETTING            │
│                                 │
│      Proposing Institution      │
│         (FEPA/NESREA)           │
│                                 │
│   •  To Establish National      │
│  Ambient Air Quality Standards  │
│            (NAAQS)              │
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┌──────────────────────────────────┐
│   BASELINE AIR QUALITY           │
│   ASSESSMENT AND AIR             │
│   QUALITY MONITORING             │
│                                  │
│   Implementing Institution       │
│   (NESREA ZONAL OFFICES)         │
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┌─────────────────────────────────┐
│   IMPLEMENTATION OF             │
│   INTERVENTION STRATEGIES       │
│                                 │
│  • Enforce the policies and     │
│    regulations                  │
│  • Ensuring Emissions are within│
│    NAAQS AND WHO air quality    │
│    guidelines                   │
│                                 │
│   Implementing Institution      │
│  • NESREA                       │
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│   INTERVENTION                   │
│   STRATEGIES                     │
│                                  │
│   •  Setting of NAAQS            │
│                                  │
│   Enforcing Institutions         │
│        (NESREA)                  │
│                                  │
│   •  Formulation of  Air         │
│      Quality Act (AQA)           │
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│         CLEAN AND SAFE AIR                     │
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Figure 1: Air Quality Management Intervention Framework

6.0. Recommendations

A comprehensive air quality control policy/act that focuses on multiple pollutants and emission sources at both the zonal and national levels is recommended to mitigate air pollution issue in Nigeria. The options for a comprehensive air quality policy include:

a. development of national ambient air quality standards, clean energy resources;
b. promotion of clean and efficient use of coal;
c. enhancement of vehicle pollution control;
d. implementation of synchronous control of multiple pollutants including SO_2, NO_x, VOC, and PM emissions;
e. joint prevention and control of zonal air pollution; and
f. application of climate friendly air pollution control measures.

It is recommended that the necessary capacity is built at the various NESEREA zonal offices to undertake focused analysis as well as scrutiny of intervention programmes to improve the air quality in the country. These NESEREA zonal offices would serve as pollution control boards for each of the six geopolitical zones. It is also recommended that regular programmes for the dissemination of information are organized by appropriate bodies and stakeholders to raise the awareness of the dangers of air pollution and best practices to reduce it.

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